APPLICATION OF

HENRIK ASPE

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GEOFFREY S. GATES

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ADAPTIVE INTERACTIVE PRECEPTORED TEACHING SYSTEM

James J. DeCarlo
Registration No. 36,120
Attorney for Applicant
STROOCK & STROOCK & LAVAN LLP
180 Maiden Lane
New York, New York 10038
(212) 806-5400

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Name Susan Powell

Signature

TITLE OF THE INVENTION

ADAPTIVE INTERACTIVE PRECEPTORED TEACHING SYSTEM

FIELD OF THE INVENTION

[001] The present invention is directed generally to an adaptive and interactive system for teaching. More particularly, this invention concerns a system which tailors information sent to the student according to the student's identity. The system can provide for monitoring of the student's performance by the teacher and, where appropriate, direct communication between the student and teacher.

BACKGROUND OF THE INVENTION

[002] Knowledge can always be acquired by the truly inquisitive. However, certain formats are better adapted to specific goals.

[003] An encyclopedia – whether in print, CD-ROM, or online – tries to encompass all knowledge that is relevant to a subject. The user of an encyclopedia expects to find the answer to virtually all questions about the subject. The most typical use of an encyclopedia starts with a query and ends with separating the relevant article, or even paragraph, from the mass of information that comprises the encyclopedia. Few users of an encyclopedia sit down to read the entire contents. In other words, an encyclopedia does not provide any cohesive educational framework which might guide the student.

[004] Computer format encyclopedias have used various strategies to move beyond the limited role of answering queries. Feature articles that change each time the program is launched try to redirect the reader's attention to new subjects. Slideshows and guided tours also use the encyclopedias resources to draw the reader into areas where self-directed queries would never have gone. Encyclopedias can answer questions and even entertain the reader with knowledge, but none document the reader's competence in a subject.

[005] A preceptored (taught) course is fundamentally different than an encyclopedia. The purpose of a preceptored course is to assure that a student who completes the course requirements has competence in the subject. A course may draw on the resources of an encyclopedia, but the lessons are arranged and directed by a teacher who sets objectives. The best teachers incorporate the interests of their students into the design of the course, but the overall direction of the course is still defined by standards that are set by experts to insure competence.

[006] Live teaching has a number of drawbacks - the teacher must be compensated, space must be found for the program, and participants must all meet at the appointed place.

[007] Physicians strive to provide the highest possible quality of care to those who have requested their services. Comprehensive education is an essential component of quality care for a person having diabetes. Physicians providing high-quality diabetes care may find their job complicated by the limited time that patients have available to complete their evaluations and the prohibitive costs of extensive individual instruction.

[008] Thus, there is a substantial need for an educational program which provides the benefits of both encyclopedic and preceptored education.

[009] One area where there is a pressing need for an improved educational system is in the ongoing treatment of diabetes. Good diabetes care challenges a person who often has no symptoms to make significant lifestyle changes and to take numerous medications on the belief that reaching certain numerical goals in the present will reduce the risk of complications in the future. Diabetes education has been recognized as an essential component of good diabetes care. Diabetes education should help patients acquire the knowledge and support the attitudes necessary to accept this challenge.

[0010] Improved outcomes have been demonstrated when the primary care provider combines an intensive program of patient education with attention to recommended quality of

care measures. However, diabetes education is expensive and inconvenient to provide, while tracking quality of care measures can be lost in the details of providing care to a broad range of patients in a busy practice. Referring patients to community classes, suggesting books or even diabetes references online do not assure that the individual patient will acquire the knowledge and skills necessary to reach accepted quality of care measures.

[0011] An intensification of treatment is more likely to be successful if the change is made as soon as the patient is motivated to change. This requires that education to inform and motivate patients be linked directly to the physicians and nurses who have the ability to help patients make changes in their diabetes care.

[0012] A preceptored course with frequent testing and free communication between teacher and student assures that the student who completes the requirements has competence in the subject. Frequent communication with a knowledgeable health care provider can also sustain the motivation of a patient to adhere to the complex and burdensome requirements of good diabetes care. It is, however, expensive to provide such an education.

[0013] Neither computer games nor interactive educational programs for diabetes are new. However, no current program integrates a preceptored course of instruction with the tracking of individual quality of care measures from the patient's clinical record.

[0014] There is a further need for an interactive, adaptive educational system which can be used to improve diabetes care.

[0015] There is also a particular need for an interactive Internet educational course providing an alternative to individual counseling

SUMMARY OF THE INVENTION

[0016] In its preferred embodiment, the present invention links a patient's medical care in the physician's office to personalized education and brief online interactions with a nurse between office visits. This can improve the quality of patient care in a cost efficient manner.

[0017] The present invention is particularly suited for use with a preceptored diabetes course designed to help persons with diabetes obtain the best possible care. The course provides in a novel way reliable information on diabetes, and the information sent to patients is individually tailored based on each patient's registration data.

[0018] Providing tailored educational courses for patients has many benefits. Certain topics or perspectives will be appropriate for some patients but not for others. For example, a person with established diabetic retinopathy is more interested in options for treatment than in learning how they could have prevented this complication by better diabetes control. Other topics are based on the patient attitudes toward diabetes care that have been discovered in the patient's response to questions embedded in the program.

[0019] The technology of the internet can support an interactive education program customized to the patient and provide secure email communications with a preceptor. The present invention preferably employs the Internet to link the convenience of a personalized online diabetes course through secure communication with a nurse and/or the patient's physician. The physician can become involved when appointments are necessary.

[0020] A method for remote education of a student involves providing lessons, obtaining a profile for the student, the profile including at least one value describing one of the student's attributes, using the profile to select one of the lessons to be sent to the student, and sending the selected lesson to the student.

[0021] Another aspect of this invention relates to a method for the remote education of a student. This can be done by providing a set of lessons, obtaining a profile for the student

which includes at least one value describing an attribute of the student, using the profile to select one of the lessons to be sent to the student, sending the selected lesson to the student, administering and then grading a quiz based on the selected lesson to the student, offering to inform the student of the quiz result, and offering to inform a preceptor of the time taken by the student studying the lesson and the quiz result.

[0022] If desired, the profile can be updated to reflect the quiz result. Information can be exchanged over the Internet, possibly in secure fashion. Student performance can be analyzed statistically.

[0023] Another benefit to this invention is that the educational process can be preceptored by a certified diabetes educator ("CDE"). The CDE monitors each patient in the course using website connection tracking data as well as the patient's responses to questions that are included with each course topic. Secure email allows the preceptor to offer encouragement as necessary. Patients can use secure email to ask the preceptor educational questions. Reports by the CDE / preceptor are sent to each patient and to each patient's physician. Patients "pass" the course by completing a required number of sections and achieving an adequate score on the factual questions in the text.

[0024] Each patient has secure access to their own healthcare data. This will provide the patient with a beneficial feeling of trust. Using a secure private webpage patients and their physicians can set goals and chart progress toward meeting these goals.

[0025] The present invention also can track performance of a group of patients, as well as individual patients in the group. Quality measures that could be monitored include patient satisfaction, knowledge, attitudes, behaviors and both clinical and laboratory based process outcomes. Reporting algorithms would accumulate data to satisfy the differing requirements of the several organizations concerned with diabetes care.

[0026] The present invention can be used to define clear objectives for the patients in the course. The objectives are chosen to improve clinical outcomes that have been shown to substantially affect the health of persons with diabetes. Educational content of the course may focus on changing behaviors that affect the attainment of these goals. Education of the person with diabetes is coupled with specific clinical and laboratory data that is shared with both the patient and the patient's physician. A CDE / preceptor monitors the patients' progress and sends prompts to the patients and their physicians as necessary.

[0027] Direct access to the educational content of the program is given to individuals. That way the program provides a modular lesson plan with computer tabulation and scoring of questions for registered users. The availability of a diabetes course can be supplemented by publicly available healthcare information such as that in comprehensive diabetes encyclopedias.

[0028] This invention is particularly concerned with a method for the remote care of a diabetic patient who is under the supervision of a healthcare provider. That method involves providing a set of lessons, obtaining a profile for the diabetic patient which includes a value describing one of the patient's attributes, using the profile to select a lesson to be sent to the patient, and sending the selected lesson to the patient for study. The system offers the patient information reflecting the patient's health, and also offers the healthcare provider information regarding at least one of the patient's study of the lesson, the patient's health, and the patient's medical appointments. The profile can reflect the patient's a1c level, urine albumin level, cholesterol profile, body weight, body mass index, blood pressure, foot sensitivity, upcoming medical appointment, or number of lessons that have been completed. Information can be exchanged using the Internet and in a secure manner.

[0029] It is also envisioned that the profile can be updated to reflect a change in the value. The healthcare provider can be alerted when the value crosses a predetermined level.

The patient can be quizzed on the lesson sent, and the quiz results also can be used to update the profile.

[0030] Other features and advantages of this invention will become apparent in the following detailed description of preferred embodiments of this invention, taken with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] FIG. 1 depicts a scheme for an adaptive interactive preceptored teaching system for communication using the Internet between a supervisor, a preceptor and a student;

[0032] FIG. 2 is a schematic view showing components of the system depicted in FIG. 1;

[0033] FIG. 3 is a flowchart illustrating various actions which can be taken as the physician (supervisor) uses the system depicted in FIGS. 1 and 2;

[0034] FIG. 4 is a flowchart illustrating various actions which can be taken as the patient (student) uses the system depicted in FIGS. 1 and 2;

[0035] FIG. 5 is a flowchart illustrating an alternate embodiment of the various actions which can be taken as the patient uses the system depicted in FIGS. 1 and 2;

[0036] FIG. 6 is a flowchart illustrating various actions which can be taken as the CDE (preceptor) uses the system depicted in FIGS. 1 and 2;

[0037] FIGS. 7A-P are "screen shots" of web pages according to a particular aspect of the present invention;

[0038] FIGS. 8A-C depict a content matrix containing educational modules which are used in the present invention;

[0039] FIG. 9 is a schematic view showing a number of client and server computers communicating in known manner via the Internet; and

[0040] FIG. 10 is a schematic view showing various components of both client and server computers.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0041] The present invention relates to a system for remote learning in which at least some of the educational content sent to the student is selected based upon one or more identifying characteristics of the student. In other words, this invention adapts the educational program to take into account the identity of the student. Although educational content is delivered automatically, the system is preceptored in that the system keeps track of each student's performance. Where a student's performance falls below some predetermined minimum level, the system alerts the preceptor, who can take suitable action such as making direct personal contact to help the student learn.

[0042] The following definitions are used in the description of this invention:

[0043] CDE: certified diabetes educator, a nurse or other health professional having specialized training in the care and monitoring of diabetics.

[0044] Content Matrix: refers to a collection of educational modules which are selected and sent to students. Different students may receive different modules so as to tailor teaching content to the students' own needs.

[0045] Educational Content: the collection of educational modules from the content matrix which are sent to a student.

[0046] Educational Module: a single entry in the content matrix having information to be taught to the student and which also may include questions to measure the student's proficiency with the material studied.

[0047] Patient: person under the care of a physician and a CDE. The patient is a student.

[0048] Physician: doctor having supervisory responsibility for a patient.

[0049] Preceptor: person having direct responsibility for educating a student by monitoring the student's performance and, when appropriate, intervening to provide the student with additional teaching. That additional teaching can involve using the adaptive system to provide the student with opportunities to repeat lessons already studied or to cover new lessons. If appropriate, the preceptor can provide the student with direct teaching, whether by remote communication such as e-mail or in person. A CDE is a preceptor.

[0050] Profile: A set of criteria such as gender or age corresponding on an individual basis to member of a group of students, and which determines the educational content that is sent to the member.

[0051] Quiz: any interactive scheme for determining a student's mastery of an educational module. Commonly given in the form of a series of multiple choice questions.

[0052] Student: an individual participating in an adaptive interactive preceptored teaching system.

[0053] Supervisor: an individual such as physician having oversight responsibility for the interactive preceptored teaching system.

[0054] This invention generally involves a remote automated tailored teaching system through which a student, preceptor and supervisor all can interact via communication lines and the Internet. The student is sent educational content chosen to fit the student's particular needs, and the student, preceptor and supervisor can monitor the student's performance. Should the student's performance become unacceptable, the system will notify the preceptor and/or supervisor so that remedial action can be taken.

[0055] The present teaching system is intended to improve the educational process by increasing a student's interest in learning. Students often learn best where they receive personalized education, and where the material taught has direct applicability for the students. To help maintain the student's enthusiasm, the teaching system sends each student status information showing how the student has performed in the past. To personalize the education process, the system employs a profile of relevant student information to determine what educational information should be sent. By way of non-limiting example, each student could be sent performance data summarizing their results on previous quizzes. Students also could be sent information comparing their performance to that of others using the same teaching system, i.e., each student could be told their current rank in the group.

[0056] The term "group" is used loosely, and refers to a collection of students who are engaged in the same course of study. The students need not be in each others presence, nor need the students even know of the existence of other members of the group.

[0057] More specifically, the present invention can for any student call up that student's profile information. Using suitable decisionmaking algorithms to select appropriate education modules the system generates and sends to the student educational content tailored to the student's own profile.

[0058] While one focus of this teaching system is to provide an automated remote teaching system, another is to automatically alert the preceptor to any student whose performance is becoming unsatisfactory. This way, the preceptor can offer a student having difficulty additional instruction. By way of non-limiting example, additional instruction could involve repeating all or part of a previous program of educational content, or could consist of direct one to one instruction by the preceptor.

[0059] Other aspects of this invention allow preceptors and the supervisor to statistically analyze the students' test results. Statistical analysis can serve a two-fold purpose.

Analysis can help to identify students having particular difficulty with the educational program, and it also can be used to determine whether any portions of the teaching materials and/or their corresponding quizzes may require modification. That is, portions of the educational program having significantly lower pass rates than other sections may not be sufficiently clear, and so may benefit from rewriting. Preceptor performance also can be monitored in this manner.

[0060] Another way to look at the present invention is as a system for facilitating communication between the supervisor, preceptor and student. With reference now to FIG. 1, it will be seen that student 1, preceptor 3 and supervisor 5 all exchange information via the Internet (the Internet and the manner in which communication over the Internet is performed are discussed elsewhere in this disclosure). Each party can both send and receive data over the Internet.

[0061] In some cases it may be appropriate to provide for secure communications between each of the parties. In that case, known security protocols can be employed. By way of non-limiting example, each supervisor 5, preceptor 3 and student 1 can be given a unique login name and password which must be accepted by the system before the system can be accessed. Although FIG. 1 depicts only one supervisor 5, preceptor 3 and student 1, it should be understood that this is also by way of example and not limitation.

[0062] Communication is an important part of the education process. The present system enables the student 1 to communicate electronically both with the preceptor 3 and the supervisor 5. By way of non-limiting example, the student 1 can send and receive e-mail messages with both the preceptor 3 and the supervisor 5. The student 1 also can both electronically check his previous performance and receive new educational content. Education content can be tailored to the student's own needs. If the education program includes a testing component, the student 1 can send his test answers in using the Internet. Test results can be

returned to the student 1 by Internet as well. Where the student's performance may fall below some acceptable minimum, the student 1 can be sent a warning and additional educational materials. The student 1 even may even be able to engage in independent study, say, by looking at a list of Frequently Asked Questions ("FAQ"), or studying content modules of personal interest contained in a general searchable matrix of modules. Links to other sources of relevant information such as government websites also could be provided.

[0063] With continued reference to FIG. 1, supervisor 5 generally serves an oversight function, making sure that the educational program as a whole is operating effectively. To accomplish this goal, supervisor 5 can monitor certain indicators which reflect the performance of each student 1 and preceptor 3. Another aspect of this invention therefore involves providing the supervisor with a data analysis package for statistically evaluating test results. Using the data analysis package the supervisor 5 can measure student and preceptor performance and also can see whether any of the educational materials require modification.

[0064] To this end, the supervisor 5 can communicate individually and securely with each preceptor 3 and/or patient 1.

[0065] Preceptor 3 plays several roles in this teaching system. Preceptor 3 is responsible for registering new students 1 so that they can use the teaching system, responding to all questions that students 1 may pose, and serving as a bridge between the students 1 and the supervisor 5. Preceptor 3 also monitors the performance of each student 1 to verify that the student 1 is mastering the material being taught. This monitoring might involve checking each student's quiz scores to identify those students having difficulty learning the material presented. Alternatively, a more complex statistical analysis could be conducted.

[0066] When student 1 has been identified as not performing at the required level, the preceptor 3 can contact that student 1 and arrange for remedial action such as having the

student 1 repeat one or more lessons or receive intensive one-on-one tutoring with the preceptor.

[0067] Preceptor 3 can communicate with supervisor 5 to seek advice for any student 1 whose performance indicates the student 1 may require special attention. Preceptor 3 also can communicate with supervisor 5 if a student 1 asks a question which the preceptor 3 is unable to answer, or where preceptor 3 herself has some question. The preceptor 3 also can respond to questions posed by preceptor 5.

[0068] Turning now to FIG. 2, a preferred embodiment of this invention will be discussed.

[0069] As FIG. 2 shows, student 101, preceptor 103 and supervisor 105 interact with one another through a teaching system 111. By way of non-limiting example, communication can take place at least in part using the Internet 107. Student 101, preceptor 103 and supervisor 105 each communicate with the Internet 107 via signal lines 121, and teaching system 111 communicates with the Internet '107 through lines 121'. It should be understood that although FIG. 2 depicts three Internets 107, they are the same Internet 107. Lines 121' could all be the same line or could be separate lines.

[0070] The student 1010, preceptor 103 and supervisor 105 can access the Internet in known manner, for instance, by using personal computers (not shown).

[0071] By way of non-limiting example, teaching system 111 can include a computer server 113 of known design. Computer server 113 functions to route information such as messages between student 101, preceptor 103 and supervisor 105, and performs other functions which will be described.

[0072] As depicted in FIG. 2, computer server 113 includes an educational information database 115 and a student information database 119. Controller 117 has access to the

information in databases 115 and 119, and can retrieve data from and write data to each of those databases 115 and 119.

[0073] Educational information database 115 contains a number of distinct education modules (not shown). Each module can correspond to a single lecture, education program or article. Modules can be constructed which may be of interest to a particular subset of the group being educated. Subsets of the group can be based upon characteristics such as gender, age, occupation, medical condition and so forth. For instance, a module could be written in a manner tailored to reflect the interests of a young person, and a corresponding module could be written in a way reflecting the interests of an older person.

[0074] Student information database 119 stores profile information (not shown) for each student. Such profile information can include, but need not be limited to, information which can be used by the controller 117 to determine which educational modules from the educational information database 115 are to be forwarded to student 101. By way of illustration only, in the foregoing example the student information database 119 may include age information for each student in the group. This way, when the controller receives a request from student 101 for educational information, the controller 117 would access the profile for that student 101 in the student information database and obtain the student's age. The controller 117 would then select from the educational information database 115 the educational module which is appropriate for the student's age.

[0075] Profile information may in part be based upon the student's answers to registration questions. The student can answer those questions as part of the initial registration procedure for using the teaching system. Provisions can be made for changing the student's answers.

[0076] Each of the educational modules sent to student 101 via the Internet 107 and lines 121, 121' preferably includes a quiz having one or more questions intended to measure

the student's mastery of the material taught. The student 101, after receiving and completing the quiz, returns the quiz to the teaching system via the Internet 107 and lines 121, 121' for grading.

[0077] Controller 117 then looks to educational information database 115 to obtain the answer key for the quiz and grades the student's answers accordingly. The quiz results can be communicated to the student in several ways. By way of non-limiting example, the controller 117 automatically sends the quiz results to the student 101 as a message. Alternatively, student 101 may send the teaching system 111 a request for the quiz results, and in response the controller 117 sends those results to the student.

[0078] The graded quiz results can be sent to the student 101 either individually or in groups. For instance, the grades for all of the modules on a particular subject could be sent to the student 101 at the same time.

[0079] Another function performed by the teaching system involves the statistical analysis of both student 101 and preceptor 103 performance. By statistically analyzing student performance to identify any student 101 whose performance is substantially below that of others in the group, the preceptor 103 can be alerted to take appropriate remedial action to aid the student 101. Promptly taking remedial action means the student 101 should not fall far behind other group members.

[0080] Statistical analysis also can be used to determine the preceptor's effectiveness. Preceptor performance can be measured by comparing the performance of one preceptor's group of students to the performance of the other preceptors' groups of students, or to a historical reference database or standard.

[0081] Statistical analysis of student performance also means that test material effectiveness can be evaluated. Questions, whether multiple-choice or fill-in, found to have statistically aberrant pass rates may be too difficult or too easy. For example, where a question

has a much lower pass rate for all students than other questions in the quiz, it is likely that the question is confusing or tests material that the students have not mastered. In like manner, a question found to have a much higher than expected pass rate may be too easy.

[0082] Once identified, questions having unexpected pass or failure rates can be reviewed and, if necessary, reworked or deleted.

[0083] The statistical methods which are used to analyze student and preceptor performance and question effectiveness are themselves known, and so will not be described further.

[0084] Controller 117 also performs functions such as routing messages between student 101, preceptor 103 and supervisor 105. By way of non-limiting example, messages may take the form of e-mail communications. Known e-mail schemes can be employed.

[0085] Depending upon the nature of the educational program implemented it may be desirable to insure that the teaching system is secure against unauthorized use. The teaching system can therefore require students, preceptors and supervisors to log in using a recognized login name and password. Until a recognized login and associated password are entered, the system will not allow further action. This will prevent unauthorized tampering with the system.

[0086] The creation, maintenance and deletion of login names and passwords is typically performed by a system administrator. In the present invention it is envisioned that the preceptor will be able to create student-level logins.

[0087] Depending upon the subject matter being taught and the nature of the information being sent, for example, student personal data, secure communications between each of the students 101, preceptor 103 and supervisor 105 and the teaching system 111 may be required. Such secure communication can be carried out in known fashion using available secure e-mail and Internet-based communication systems.

[0088] A particularly preferred embodiment of this invention for use in the treatment of diabetes will now be described.

[0089] Diabetes is a widespread and serious illness affecting millions of people worldwide. Proper diabetes care requires constant monitoring and action by both those affected and their healthcare providers. Typically, diabetics monitor on a regular basis basic vital signs such as blood sugar and cholesterol. Diabetic care also includes an educational component; patients receive instruction in the causes, symptoms and treatment of diabetes, and are taught by Certified Diabetes Educators (CDEs) how to properly care for themselves. They also must regularly visit their physicians to have their general health assessed. Physicians study various indicators to evaluate a patient's condition. Blood chemistry, foot sensitivity, eyesight and blood circulation all may be checked.

[0090] Because such monitoring, care and education is time consuming, patients may gradually "slack off" and become less vigilant in their efforts. Consequently, anything which can be done to maintain patient interest in their own care so that they continue to monitor properly their condition, meet regularly with their CDE and physician, and continue their education can improve patient health.

[0091] The present invention is well-suited for diabetic care. Because this invention tailors the educational process to reflect the needs of each patient (student) and provides each patient (student) with an assessment of their performance, those using this system receive personalized health care. Diabetics, like most people, enjoy receiving attention; where patients are able to participate in a health care program which they perceive as being tailored to their own needs they may be more enthusiastic about the program and more likely to adhere to the program's guidelines.

[0092] Patients also may like the convenience of a remote education and monitoring system, since they can study at home. Patients also may enjoy the "high-tech" aspect of this

system, which allows them use a personal computer to study, monitor their health and communicate with CDEs and physicians using the Internet and e-mail.

[0093] In the following discussion of particular aspects of this embodiment, the terms "patient", "CDE" and "physician" are respectively synonymous with and are used in place of "student", "preceptor" and "supervisor".

[0094] Next the manner in which the physician, patients and CDE' interact with the teaching system will be discussed.

[0095] Physician Use of System

[0096] As depicted in FIG. 3, the present invention allows a physician to monitor the performance of each participating diabetic patient under the physician's care. The physician also can monitor the CDE's performance. If necessary the physician can communicate with patients and CDEs via secure e-mail. This functionality is provided through the use of suitable server software at the website on which the teaching system is hosted and client software loaded on the physician's own personal computer.

[0097] The physician accesses the teaching system by submitting a login name and password in step S1. The teaching system then returns a message either confirming or denying access, the latter being sent where incorrect or expired login information has been used.

[0098] Once the physician has accessed and been accepted by the teaching system the system in step S3 sends the physician startup status information. Preferably, the system first notifies the physician of any urgent matters. By way of non-limiting example the system may notify the physician of any patient who has requested immediate contact with the physician or who has otherwise indicated a pressing medical problem. Urgent messages from the CDE also can be displayed.

[0099] This urgent information can be displayed by itself on a webpage or it can be displayed as part of another webpage. It is thought that the importance of this information will be best appreciated if the information is displayed by itself.

[00100] After notification of any urgent matters the system can then display general status information for the entire group of patients, such as the group's average test score, general level of compliance with the diabetes care program, and so forth. This will give the physician enough information to determine whether immediate action is required. For instance, special situations can be brought to the physician's attention. By way of non-limiting example, patients missing more than a predetermined number of doctors' appointments over a particular period of time may be identified. Other indications of poor patient compliance with the care program, such as a patient's receiving a very low score on a quiz, may be listed.

[00101] As with the urgent information, the non-critical information can be displayed by itself or it can be included in a box on a webpage containing other information as well.

[00102] A calendar of upcoming appointments with patients or other events also can be included, either as its own webpage or as part of another webpage.

[00103] Following display of any urgent information and any opening messages, the system displays a main webpage from which the physician can access all of the available system functions. These functions can include the following: communications; individual performance status; and statistical analysis.

[00104] As shown in step S5, the physician, using the system's communication function, can both read messages received from others in step S7 and send messages to others in step S9. These functions can be implemented in whole or in part using an available e-mail program such as Microsoft Outlook, Microsoft Outlook Express, or Lotus ccMail.

[00105] The physician also can in step S11 check on an individual patient's status to see how the patient is interacting with the teaching system. After activating this portion of the

system in step S11, the physician in step S13 identifies the patient for whom information is sought. This can be done by entering the patient name or selecting the patient's name from a displayed list of group members.

[00106] Having selected the patient for whom information is sought, the physician can choose to receive any of several different categories of information. In step S15 the physician can check to see how the patient's education is proceeding. By way of non-limiting example, the physician receives the patient's quiz grades, sees how long the patient spent on the quiz, as well as how long it took the patient to complete the lesson corresponding to the quiz.

[00107] In step S17 the physician can see whether the patient has been keeping his appointments with healthcare professionals, including the CDE and any other doctors. This can be informative because a sudden change in attendance habits or absenteeism may be an indication that the patient is having problems.

[00108] As explained in greater detail below, the present invention provides each patient with a set of goals, such as attaining a particular body weight, changing their blood sugar readings to a certain value, and completing a set number of educational lessons on the subject of diabetes. The physician can in step S19 monitor the patient's efforts to achieve these goals, and, if necessary, take suitable action such as giving the CDE instructions or contacting the patient with congratulations or to discuss the patient's efforts. It is envisioned that when the physician requests this information the system displays that information in tabular form, which can aid the physician in evaluating the patient's performance. By way of non-limiting example, goal information could be displayed in column format, with the first column identifying the nature and numerical value of the goal (i.e., body weight 145 lbs), the second column reflecting the patient's level of performance (i.e., weight 147), and the third column numerically quantifying the patient's performance (i.e., weight 101.9% of goal). Taken together this information may help the physician to evaluate the patient's efforts.

[00109] Alternatively, all of the foregoing information could be displayed immediately on a single web page once the physician has identified the patient for whom information is sought.

[00110] Statistical analysis can be a powerful tool for detecting when a patient may not be following a proper course of care. The physician can request statistical information for the patient, group of patients or the CDE in steps S23, S25 and S27, respectively. Using statistics it is possible to determine when poor patient performance is more than an isolated occurrence, but rather, is indicative of a more serious problem. Statistics also can be used to determine when all members of the group are reacting in the same way, as might be the case where a question in one of the quizzes testing mastery of an education module is ambiguous.

[00111] In the same way statistics can be used to see whether the CDE's performance deviates significantly from that for other CDEs. For instance, if it is found that the number of patients of a particular CDE who routinely miss medical appointments is statistically greater for one CDE than for other CDEs, it is possible that the CDE is not emphasizing sufficiently the importance of keeping such appointments. In that case the physician can contact the CDE to discuss this point and suggest ways to improve the CDE's performance.

[00112] Patient Use of System

[00113] Use of the teaching system by a patient will now be explained in connection with FIG. 4.

[00114] As previously noted, patient participation may be improved when patient interest in the program is increased. To this end, the webpages sent to the patients should be interesting enough to attract and retain patients. To emphasize that the teaching system is personalized, it may be beneficial to put each patient's picture and the picture of their physician on "their" webpages.

[00115] To insure privacy and security, the patient first submits a unique login name and password in step S101. Only after the login name and password have been accepted can the patient obtain access to the teaching system. The patient cannot access information for other patients.

[00116] The teaching system then returns a message either confirming or denying access, the latter being sent where incorrect or expired login information has been used.

[00117] When logged into the system successfully the patient receives in step S103 one ore more welcome messages and any other messages that might be appropriate for immediate viewing. By way of non-limiting example, the system could inform the patient of important upcoming events such as medical appointments. Urgent messages from the patient's physician or CDE also could be displayed (as discussed below, messages of less importance could be selectively retrieved by the patient using the system's e-mail function).

[00118] As with the physician portion of this system, the urgent information can be displayed by itself on a webpage or it can be displayed as part of another webpage. Again, the importance of this information may be best recognized if the information is displayed by itself.

[00119] After notification of any urgent matters the system then displays a home webpage from which the patient can access all of the available system functions. With continued reference to FIG. 4, exemplary system functions include e-mail access, study of diabetes educational materials, monitoring of the patient's personal goals and independent study and/or search of a general diabetes encyclopedia/database. Each of these functions will now be discussed in turn.

[00120] As shown in steps S105 the patient can access the portion of the teaching system allowing for the exchange of e-mail. Using the systems communication functions, the patient can in steps S107 and S109, respectively, retrieve and send e-mail messages. Messages can be exchanged with the CDE and physician. Optionally, a patient also could exchange

messages directly with other patients, or post messages on electronic bulletin boards. The patient, like the physician, can use an available program such as Microsoft Outlook, Microsoft Outlook Express, or Lotus ccMail to handle e-mail.

[00121] As already noted, education is an important part of diabetes care. Patients who are kept informed of the latest developments in diabetes treatment can take better care of themselves. The teaching system provides in step S111 for a remote study program in which a patient can access customized study materials using the Internet. After studying those materials the patient is quizzed to evaluate whether they have mastered the subject matter.

[00122] One particular benefit of this invention is the educational materials sent to each patient are selected according to the patient's needs. This way each patient receives an education tailored to their medical state. This manner of education is highly efficient; patients only learn what they need to know. By way of example, men need not be educated in areas of concern only to women. Younger people need not be taught about subjects which are only of concern to the elderly. People who are underweight need not be educated about how the obese should treat their diabetes. Moreover, patients may perform better and be more enthusiastic when told they are being taught just what is important for their particular medical condition.

[00123] Another important component of this invention is the content matrix, this being the name for the entire collection of all educational modules. The content matrix should be carefully prepared with educational modules for all patients, regardless of their individual profiles. In the case of diabetes it is envisioned that the content matrix defines a course having 35 topics (modules) arranged in 7 "tracks". To insure easy readability, each topic can be from about 500-900 words long, and to help generate interest may include graphics and interactive questions. In the case of diabetes case it is preferable that the course should cover the topics recommended by the American Diabetes Association for a comprehensive education in diabetes care.

[00124] The 35 topics can be chosen from a database of articles or can be prepared specifically for the teaching system. The selections sent to the patient are chosen according to data from the patient's medical record and their responses to a questionnaire on attitudes and behaviors. By way of non-limiting example, modules should be available which are appropriate for any age patient, those with and without cholesterol issues, long-term and newly-diagnosed diabetes, and so forth. Some modules may be applicable to all patients, regardless of their profile. Other modules may only be relevant for a small group of patients. Articles forming the course will therefore be specific to the patient's type of diabetes and health status as well as their attitudes and behaviors. There are about a quarter million unique combinations of articles, making this a truly customized education procedure.

[00125] The manner in which this scheme is implemented will be discussed elsewhere.

[00126] Rather than have patients complete successive educational modules, it is preferable for each patient to finish a module and then take a short quiz keyed to the contents of that module, as shown in step S111. People who know they will be tested on a subject often study with greater diligence. A further benefit to testing a patient on each educational module is that it will be possible to identify promptly patients who are not retaining the information that has been taught.

[00127] Preferably, the quiz given in step S111 is multiple choice; this way, the patient's answers can be graded automatically. Other question forms such as filling in the blanks or drop-down menus can be used, and it even may be possible to employ artificial intelligence and handwriting analysis to automate grading of such quizzes.

[00128] To maintain patient interest, quiz formats may be varied. Some educational modules could have 1-2 simple questions, followed by text and graphics (even animations) to cover the topic, and then finish with 2-3 more questions. Educational modules can deviate from this pattern as appropriate. For example, a section called "What's Your Diabetes

Attitude?" could be mostly a questionnaire with an explanation of the results. This section would be built around a validated research tool such as the DAS 3 (Diabetes Attitude Survey). Another example could be "How's Your Vocabulary?", which could have a crossword puzzle on diabetes linked to a glossary.

[00129] The grade for the quiz automatically generated and returned to the patient in step S113. The system checks in step S115 whether the patient's grade is greater than a predetermined minimum passing grade. If so, no further action is taken or a congratulations message on behalf of the CDE or physician could be sent in step S117. Should, however, the patient have failed the quiz, the system can instead send the CDE and/or physician an alert.

[00130] Optionally, the system can check as in step S119 whether the patient has taken the quiz before. If the patient has not take the quiz already, processing returns to step S111, where the patient is given an opportunity to study the educational module again and thereafter retake the quiz. If after retaking the quiz the patient is found in step 115 to have passed, no further action is taken or a congratulatory message can be sent. If, however, the patient has again failed in step 115 the system can send the appropriate alert to the CDE and/or physician in step S121. In addition, the system may in step S123 invite the patient to study a different educational module. This way if the patient passes the new educational module's quiz they will complete the session with a positive feeling of accomplishment, despite failing the previous educational module. The patient is not invited to study the failed educational module a third time, since the likelihood of a patient passing a quiz on the third try is remote, and meaning it may be more efficient to have the patient move on to another section. Instead, the CDE and/or physician, having been notified in step S121 that the patient has twice failed a module, can take personal action to teach the patient.

[00131] Insofar as the foregoing discussion speaks of sending an alert to the CDE and/or physician, it should be understood that such an alert could be an e-mail message. The CDE

and/or physician could receive a "pop-up" message or could retrieve that e-mail message at their convenience.

[00132] The patient also can use the teaching system as in step S127 to monitor their own performance on quizzes. After checking their performance in step S127 the patient may receive a message from the CDE or physician, possibly commenting on their performance or giving them other advice.

[00133] In addition, the patient in step S127 could check to see if they are being successful in caring for themselves and are succeeding in attaining their medical goals. For instance, a patient could check her "personal scorecard" to see whether her cholesterol has decreased to a goal level. The personal scorecard includes a page with the patient's demographic and clinical information that the patient can check for accuracy. Interim (such as by the next appointment) and/or personal goals are set and recorded for each patient based on consultation with the physician. An explanation of each value and/or goal can be provided, either as a text explanation or as a link to an article covering the subject. The personal goals may differ from the optimal goals if there are mitigating circumstances (e.g. hypoglycemic unawareness). This scorecard helps patients chart progress toward achieving behavioral commitments (e.g., checking feet daily, exercising so many minutes per weekday or substituting a low fat for a more typical high fat choice in so many meals per week).

[00134] By way of example, self-monitoring of blood sugar records could be plotted and analyzed with software developed for the DMR, Your Diabetes World or other diabetes monitoring programs and be used to update the appropriate personal goals.

[00135] Yet another option available to a patient using the service is independent study, shown in step S131. Independent study means that a patient logged into the system can use the system to search for general information on a diabetes-related topic (systems for other diseases could have other types of information). The patient could in step S133 look for the desired

information in either a frequently-asked-questions webpage or search through the general collection of educational modules, topic by topic. Search tools could be as basic as a general topical outline or as sophisticated as a Boolean logic search program.

[00136] If the teaching system gives the patient access to a general informational database such as a diabetes encyclopedia, the patient may in step S135 conduct a search there as well.

[00137] Still another search option, as shown at step S137, is a general system search. This feature may be useful where a patient recalls seeing something on the website but cannot remember where. The search could take the form of a text search of all web pages in the web site.

[00138] FIG. 5 is a flowchart depicting alternative steps which can be performed when a patient interacts with the computer system used to implement the present invention.

[00139] In step S201 the patient logs into the system by submitting her login name and password. Once the patient is recognized the system can display on the patient's computer the patient's "scorecard" of important vital statistics, along with any other information that is appropriate such as the existence of an upcoming medical appointment.

[00140] In step S205 the system can advise the patient that there is a message waiting. This way the patient learns immediately upon login that she has a message, instead of waiting until the patient remembers to check her e-mail.

[00141] Following these start-up procedures the patient can then choose either to send and/or receive messages, do coursework, or simply obtain information from the teaching system.

[00142] Reading and sending messages, as in steps S207 and S209, can be accomplished using e-mail in the manner already described.

[00143] If the patient chooses in step S211 to begin or continue her coursework, the patient sends the teaching system a request in step S213 to receive the next lesson. This request is preferably made electronically over the Internet. After receiving this request the teaching system in step S215 checks the patient's profile information (such information can be kept in a student information database 119 as shown in FIG. 2) to ascertain what lesson the patient should be sent.

[00144] The teaching system selects in step S217 the course to be sent to the patient. The precise manner in which the course is selected is discussed else where.

[00145] After waiting for the patient to finish her study of the course data in step S219, and upon the patient's request, the teaching system in step S221 sends the patient a quiz corresponding to that course data. After the patient sends the teaching system her answer(s) to the quiz, the teaching system in step S223 grades those answers. In step S225 the quiz results may be stored and the patient's profile updated to reflect completion of the topic; this way, the patient will not in the future be sent the study materials for that topic.

[00146] The teaching system check to see whether the patient has achieved a satisfactory quiz score, and/or has completed reading the study materials in an acceptable time. This is done in step S227. If in step S227 it is found that the patient's performance results are not acceptable, an alert can be sent. The alert may consist of a message to the patient, CDE and/or physician. If the patient is performing satisfactorily, the process ends at step S231. Optionally, a message of encouragement could be sent.

[00147] CDE Use of System

[00148] Use of the teaching system by a certified diabetes instruction (CDE) will now be explained in connection with FIG. 6.

[00149] The CDE logs into the teaching system in step S301 by submitting a login name and password. Once recognized by the system the CDE can either register a new patient in step S303 or check on existing patients in step S309.

[00150] Turning first to registration of a new patient, the CDE creates a profile for the patient in step S305. Creating the profile may include giving the patient a unique login name and associated password, and entering into the teaching system profile information for the patient. By way of non-limiting example, profile information could include the patient's name, address, age, gender, type of diabetes, insulin dosage and so forth. This profile information is stored in a patient profile database such as the student information database 119 depicted in FIG. 2, and is later used by controller 117 to determine what educational material will be sent to the patient.

[00151] More specifically, each patient has a profile prepared which characterizes their relevant characteristics (relevant in terms of the goals of the educational system). By way of non-limiting example, a diabetic's profile may include their gender, age, weight, A1c level (also known as glycosalated hemoglobin, which is an indicator of blood sugar level), cholesterol, length of time that they have had diabetes, physical state and so forth. Characteristics indicative of mental state, i.e., depressed, also could be included.

[00152] Patient profile information also could be obtained by direct physician or patient input, or from other sources.

[00153] It will be appreciated that the CDE also could in step S305 edit an existing patient profile, for example, to reflect a change in medical status or a change in address.

[00154] Once the profile is complete the CDE saves that profile and exits, as shown at step S207.

[00155] The CDE in step S309 accesses information for an existing patient. Functions available to the CDE include e-mail communication, monitoring of the patient's studies,

checking on the patient's medical appointments, and seeing whether the patient is achieving their medical goals. Each of these functions will be discussed in turn.

[00156] As shown in step S311 the CDE can send and receive e-mail. Messages can be exchanged with patients and the physician. The CDE can use an available program such as Microsoft Outlook, Microsoft Outlook Express, or Lotus ccMail to handle e-mail.

[00157] One of the CDE's responsibilities is to monitor the patient to be sure that the patient is studying the educational materials and taking and performing acceptably on the quizzes provided by this teaching system. In step S313 the CDE can obtain from the system information detailing how the patient's studies are proceeding. Such information can include a listing of educational topics that the patient has studied, the patient's quiz grades and the amount of time spent studying.

[00158] Software allows the CDE to monitor how much time the patient spends on each section. Too little time suggests that the patient is only taking the questions – not taking the course. Too much time suggests that the material may be too difficult and prompt a response from the preceptor.

[00159] Moreover, if the whole group is taking too much time in one section, then the section may need to rewritten.

[00160] At the end of the course, this monitoring allows the CDE to certify that the individual/group has completed the recommended hours of instruction in diabetes self-care knowledge and skills.

[00161] If in step S315 the CDE finds the patient's performance is not acceptable, the CDE may then choose to contact the physician in step S317 to decide how to proceed. Alternatively, if the patient's performance is satisfactory, the CDE can in step S319 send the patient a message of praise, or in some other way acknowledge the patient's accomplishment. Such recognition may be a factor in motivating the patient to continue studying.

[00162] In step S321 the CDE can check to see whether the patient is keeping all of his scheduled office visits. If CDE determines in step S323 that the patient is not keeping appointments the CDE again can contact the physician in step S317. Patients keeping their appointments can be sent a message of recognition in step S319.

[00163] Still another role of the CDE is to monitor the patient to see if the patient is achieving her overall health goals. In step S325 the CDE can check on the patient's health goals and see whether the patient is moving toward or away from those goals. Patients nearing their goals can be sent a message of encouragement in step S319. If a patient is having difficulty and is moving away from their goal, the CDE can contact the physician in step S317 to work out a course of action.

[00164] The foregoing aspects of operation of the present teaching system can be implemented through the use of suitable computer programs, including and not limited to Internet browser and e-mail programs and database management programs. Persistent cookies, Java applets and ActiveX controls all can be used to provide the requisite functions. It is believed that in view of this disclosure such programs could be adapted without further inventive effort to accomplish the goals of the present invention. Group reporting could be implemented by exporting various data fields for each patient such as topics completed to a spreadsheet program such as Microsoft Excel.

[00165] Next, particularly preferred aspects of the invention will be described in the context of an interactive adaptive teaching system for diabetics which sends and receives information using the Internet.

[00166] With reference now to FIGS. 7A-F, examples are shown of webpages that are sent to diabetic patients using a teaching system in accordance with this invention.

[00167] FIG. 7A depicts the initial login page seen by a patient wishing to obtain access to the teaching system. This webpage contains fill-in boxes where the patient can enter their login name and passwords.

[00168] FIG. 7B depicts the "main menu" webpage that is displayed once the patient has successfully logged into the teaching system. From the "main menu" webpage the patient can obtain their medical information and access the educational and messaging functions of the system. The webpage has a title section ("Guide to Good Care"), and a personal information section giving information such as the patient's name, physician, important medical facts, and whether the patient has any unread messages. The webpage also includes links to the patient's "Personal Scorecard" and "Message Center". Clicking the link to the "Personal Scorecard" lets the patient obtain their medical information, as shown in FIG. 7F. For convenience, the personal information section is separated from both the "Personal Scorecard" and "Message Center" sections by the main text section. The main text section displays the information associated with the webpage (images also could be embedded therein).

[00169] The webpage includes near the top links to a number, here, seven, of "Tracks". Each track corresponds to a general topic, and each track consists of one or more individual articles (previously referred to as educational modules). By way of non-limiting example, Tracks 1-7 are entitled "Getting Good Care", "What is Diabetes", "Healthy Eating & Exercise", "Using Medications Wisely", "Family, Friends & Feelings", "Complications" and "Special Situations". These modules are shown in FIGS. 8A-C and are discussed elsewhere.

[00170] To avoid patient confusion, other webpages sent to the patient preferably have the same general layout as the "main menu", and may include a link allowing the patient to return immediately to the "main menu" page.

[00171] By way of non-limiting example, FIG. 7C depicts the webpage seen by the patient after clicking the link to Track 2. This page, it should be noted, is generally similar in

layout to the "main menu" page shown in FIG. 7B. The title of the page has changed to the Track title ("What is Diabetes") and the text portion of the page provides the patient with a discussion of the subject. The webpage includes on the right hand side a "Topics" section containing links to each of the articles which make up the Track, here, "Before You Had Diabetes", "What Causes Diabetes", "Effects Of Diabetes", And "Who Gets Diabetes". Clicking one of these article links will bring up the article.

[00172] FIGS. 7D(1-2) depict the article entitle "What is Diabetes". The article text is displayed in the central portion of the web page. Captioned photographs are found to the right of that text. Some of these photographs/captions may include links to other webpages; a link ("See How it Works!") is provided beneath the illustration of a heart in FIG. 7D(2).

[00173] A link to the associated questionnaire ("NovoTrack Checkpoint Q & A") is found at the bottom of the article, as seen in FIG. 7D(2). Clicking this link will take the patient to the quiz web page(s).

[00174] FIG. 7E depicts a sample quiz question. The question is a True/False question, and to answer the user clicks on the appropriate box. Links to the previous page and next question page are provided. As an alternative to the check boxes, drop-down menus could be used.

[00175] FIG. 7F depicts the webpage sent to a patient who has clicked a link to access their "Personal Scorecard". The title of the webpage has changed to "Personal Scorecard". The central text portion of the webpage briefly explains what the Personal Scorecard shows. The right-hand portion of the page contains the patient's relevant health data such as cholesterol, blood pressure, lists upcoming medical appointments (i.e., Eye Examination 10/25/01), and may have links to other information such as Personal Goals. The left hand side of the webpage gives more general information such as the name of the patient's physician, and this information can but need not be shown on other webpages as well.

[00176] Also found at the top of the "main menu" page are links to FAQs (frequently-asked questions), a glossary, credits, legal information and a home page.

[00177] If desired, a short, annotated list of major organizations that provide reliable information about diabetes could be included. Examples are MayoHealth, the American Diabetes Association, American Association of Diabetes Educators, and the National Institutes of Health (NIDDK).

[00178] With reference now to FIGS. 7G-P, examples of webpages which can be accessed by the CDE when using this invention are depicted.

[00179] FIG. 7G depicts the "main menu" webpage which is displayed immediately after the CDE has successfully logged into the teaching system. The webpage gives the CDE a choice of operations such as "Profile", "Message Center", "Appointments", "Outliers/Alerts" and "Outline", each of which will be explained hereafter. By clicking on these tabs the CDE can access the functions associated with each tab, as will now be explained. If desired, links to other websites could be included, such as a link to the system administrator. Other webpage formats such as drop-down menus could be used in place of the tabs.

[00180] Fig. 7G shows the webpage for "Profile". Clickable tabs and drop-down menus allow the CDE to add a new patient user profile, edit profile information for existing patients, search for patients, sort patients by name or physician name, and displays a list of patients. Clickable check boxes can be used to mark the patient whose profile is to be altered, or whose information the CDE seeks to review.

[00181] FIG. 7H depicts the webpage as the CDE would see it after clicking the "Profile" button. The displayed webpage allows the CDE to add a new patient or edit an existing patient profile (if the CDE wishes to edit an existing profile the fields already will be filled-in). The CDE can input general profile information into the appropriate fields, such as user name, password, CDE name, patient address, and so on. Some fields may be drop-down

menus, others, fillable boxes and/or check boxes. From this page the CDE also can monitor existing patients.

[00182] The webpage shown in FIG. 7H has a number of buttons ("Medical/Goals", "Reg. Questions", "Track Progress", "Appt Goals", "Alerts") which when clicked allow the CDE to input still more information and check patient status. These buttons will be discussed in turn. "Save" and "Cancel" buttons are also provided.

[00183] When the "Medical/Goals" button is clicked, the webpage shown in FIG. 7I is displayed. Various items of profile information such as patient name, physician name, type of diabetes and so forth are set out in the top portion of the page. Some, none or all of these items can be editable, whether by direct input into the field or drop-down menu. The lower portion of the webpage contains medical information; as shown in FIG. 7I, there are two tables, the one on the left containing test results, the one on the right showing blood sugar goals. The test table lists the name of the test, the patient's most recent results, the date of the test and a goal. Each entry in the table has an associated "edit" button which when clicked lets the CDE alter the values for that entry. Similarly, the blood sugar goal table lists a number of values such as the number of tests or specific test times, and an associated goal such as a number of tests or a blood sugar reading. Again, entries in the table have associated "edit" buttons which when clicked lets the CDE alter the table entries. "Save" and "Cancel" buttons are provided.

[00184] FIG. 7J shows the webpage that is displayed when the CDE clicks the "Reg. Questions" button on the Profile webpage of FIG. 7H. As depicted in FIG. 7J, the webpage sets forth a number of general medical questions to be answered by the CDE on the basis of their knowledge of the patient's medical condition. For convenience, answers to these questions are provided using drop-down menu choices, but fill-in boxes also could be used. By way of example, Question 3 requires the CDE to specify the patient's level of activity. As shown in FIG. 7J, the CDE has specified that the patient has a sedentary level of activity. An

"answer key" link is provided which allows the CDE to obtain more information about the questions asked and the possible answers. "Save" and "Cancel" buttons are provided.

[00185] FIG. 7K shows the webpage which the CDE sees after clicking the "Track Progress" button on the main webpage of FIG. 7H. This webpage displays information which the CDE can use to monitor the patient's study efforts. The webpage includes a table listing by number and name each topic in the course of study that the patient has completed, the date the patient completed the topic, the amount of time the patient spent displaying (and presumably reading) the topic, and the number of questions in the associated quiz which the patient answered correctly.

[00186] After clicking the "Appt Goals" button shown in FIG. 7H the CDE sees the webpage depicted in FIG. 7L. This webpage displays the dates of the patient's most recent and next physician's and ophthalmologist appointments (other types of medical appointments also could be listed). The CDE can enter or modify the date information by entering data in the appropriate fill-in field. Alternatively, drop-down menus or other date-input schemes could be used. "Save" and "Cancel" buttons are provided.

[00187] FIG. 7M shows the webpage sent to the CDE when the CDE clicks the "Alerts" button shown in FIG. 7H. This webpage displays any situations which may be of concern, such as a low quiz score or spending too little time studying.

[00188] FIG. 7N shows the main menu page of FIG. 7H when the "Message Center" tab is clicked. Drop-down menus allow the CDE to check whether they have received e-mail from any particular patient. A "New" button allows the CDE to generate and send a new message. Messages can be filtered by clicking checkboxes such as "unread messages only".

[00189] FIG. 7O shows the main menu page of FIG. 7H when the "Appointments" tab is clicked. The webpage includes a table listing both previous and upcoming appointments for the patient.

[00190] FIG. 7P shows the main menu page of FIG. 7H when the "Outliers/Alerts" tab is clicked. The webpage includes a table displaying the name of any patient for which there is an alert, the nature of the alert, and the date of the alert.

[00191] Clicking the "Outline" link on FIG. 7H takes the CDE to the content matrix shown in FIGS. 8A-C. This content matrix lists all of the educational modules which can be sent to patients as part of their program of study

[00192] As previously explained, at least some educational modules in the content matrix are written from several perspectives. Certain educational modules will be appropriate for some patients but not for others. For example, a young female with diabetes would be given an educational module on preparing for pregnancy that would be irrelevant to a male. The controller software allows choices from among a large number of different topics or similar topics written from different perspectives. Thus, a male with type 2 diabetes and a history of a myocardial infarction will be given different educational modules than a female with type 1 diabetes who is planning on having children.

[00193] With continued reference to FIGS. 8A-C, a detailed content matrix having all of the course modules that the teaching system may use is shown. The matrix is divided into seven "tracks" (other numbers of tracks could be used), a track being a general subject of the curriculum such as "Getting Good Care". Each "track" corresponds to one of the tracks that is displayed on the webpages accessed and viewed by the patient, such as the tracks which are shown in FIGS. 7B and 7C. Sections are uniquely identified within the content matrix using a hierarchical scheme; the leftmost character corresponds to the track, the character to the right thereof corresponds to the topic number within the track, and the character to the right of that (if used) signifies that the section is one of several alternative subsections. More specifically, section 6.2b corresponds to Track 6 ("Complications"), topic 2 ("Neuropathy"), subsection b ("Treating Neuropathy"). By way of non-limiting example, it will be appreciated that section

6.2b only would be displayed for a patient whose profile shows neuropathy is present, since diabetics presently free from neuropathy would not find this subject to be of interest.

[00194] Grouped within each track are a series of educational modules corresponding to all of the different topics that fall within the track. Each educational module has a series of associated questions. As explained in detail hereafter, some educational modules share common titles, although their content is at least in part different. It is by provision of these modules that the present invention allows the education process to be tailored to reflect the individual patient's profile.

[00195] With continued reference to FIGS. 8A-C, the teaching system includes a computer program which first obtains the patient's profile data and then selects educational modules from the content matrix on the basis of such data. Some educational modules will be displayed for all patients, such as module 2.1 ("Before You Had Diabetes"). Others will be sent to a subpopulation of patients. By way of non-limiting example, the computer program will determine whether a patient accessing track 2 is to be given access to modules 2.2a or 2.2b (both entitled "What Causes Diabetes"); module 2.2a contains information that will be of interest to patients having Type 1 diabetes, whereas module 2.2b contains information that will be of interest to patients having Type 2 diabetes. Thus, modules 2.2a and 2.2b contain different information, and the teaching system will determine which of the two modules to send to the patient according to the kind of diabetes (Types 1 or 2) indicated in the patient's profile.

[00196] By way of non-limiting example the program could be written using Fortran or any other suitable programming language. Any program able to select an education module(s) from a content matrix of education modules on the basis of patient profile information can be employed.

[00197] While the foregoing discussion of this invention emphasizes its use with the treatment of diabetes, it will be appreciated that this invention is of general applicability and can be used for any disease requiring patient education and/or monitoring. By way of non-limiting example, courses of study could be developed to help care for patients suffering from diseases such as AIDS, multiple sclerosis, coronary illness, eating disorders, mental illness and so on.

[00198] Those skilled in the art will understand that many variations on the above-mentioned webpage layouts could be used without departing from the scope of this invention. Different information and different formats could be employed. Fill-in sections and drop-down menus could be changed.

[00199] Since the present invention is meant to be used over the Internet, various aspects of operation via the Internet will now be described with reference to FIG. 9. FIG. 9 is a schematic view depicting a number of client computers C0, C1, C2 and C3 and server computers S0, S1 and S2 all connected to the Internet. Client C1 and server S1, it should be noted, are joined to the Internet by wireless connections.

[00200] Among the types of data which can be sent between the computers is HTML data (hypertext mark-up language). HTML data can integrate both text and images. By way of non-limiting example, webpages can take the form of HTML data.

[00201] HTML data is typically transferred from a provider to a recipient. When this transfer takes place over a network, the content provider uses one or more server computers each having the appropriate server software to respond to requests for data, and the recipient employs a computer having the appropriate client software to send requests for data and receive and process responses to those requests.

[00202] Users typically exchange data, including HTML data, over the Internet using Internet browser software. Examples of browsers include Netscape Navigator® by Netscape

Corporation, Internet Explorer® by Microsoft Corporation, and Opera from Opera Software A/S. Since the operation of browser software is generally known, such operation will not be described in detail.

[00203] Next, server and client computer equipment suitable for use with this invention will be described.

[00204] As depicted in FIG. 10, server 401 has a number of components, each of which will be described hereafter, connected to a bus 415. Bus 415 serves to relay commands and data between various components.

[00205] Central processing unit (CPU) 403 serves to control the internal operation of the server 401. Read-only memory (ROM) 407 is a non-volatile memory device which stores programs and data used by the CPU 403 as the server 401 starts up. Random access memory (RAM) 405 is a memory device which contains programs and data used by the CPU 403 during routine operation of server 401. Commands from an operator (not shown) are sent to the server 401 through an input device 409, which could by way of non-limiting example be a keyboard or a pointing device such as a "mouse" or trackball. Server 401 displays information through output 411. Output 411 can, for example, be a video monitor or a printer. Operating program and data files can be stored on an operation drive 413a, and data to be sent out from the server 401 to users can be stored on a content drive 413b. Drives 413a and 413b are preferably magnetic disk drives. The use of different drives 413a and 413b to store the operating programs and data separately from the content data is thought to be preferable because it facilitates the simultaneous reading of such operating information and content data. Moreover, although FIG. 10 depicts the use of two separate drives 413a and 413b, additional drives also could be provided. Alternatively, a single drive could be used.

[00206] Various types of data can be stored on server 401 for transmission over the Internet to users. Such data could, by way of non-limiting example, take the form of HTML

(hypertext mark-up language) web pages, images, text, programs, audio and video files. The server 401 can therefore function as a data source.

[00207] Server 401 has a data port 416 through which the server 401 can exchange data over the Internet with external computers such as client computer 420. By way of non-limiting example, the data port 416 could be a cable modem, telephony modem or network connection. Data port 416 is connected to the Internet by data line 418, which by way of non-limiting example could be a coaxial cable, a telephone line, or an optical fiber, or any type of such connector now known or hereafter developed. Data line 418 also could be a wireless connection such as a satellite link.

[00208] In known fashion, server 401 has a unique IP (Internet protocol) address which identifies the server and distinguishes it from all other computers on the Internet.

[00209] Data is exchanged between server 401 and the Internet in accordance with pre-established protocols. Requests for data from users and the data sent in response can be exchanged using TCP/IP (Transmission Control Protocol / Internet Protocol), UDP (User Datagram Protocol), or other protocols.

[00210] Next, client computer 420 will be described with reference to FIG. 10.

[00211] In the same manner as server 401, client computer 420 has a unique IP (Internet protocol) address which identifies the client computer 420 and distinguishes it from all other computers on the Internet. The client computer's address can be either static or dynamic.

[00212] Client computer 420 includes a bus 417 through which commands and data flow between the client computer's different components. Central processing unit (CPU) 419 controls internal operation of the client 420. Programs and data used by the CPU 419 during start-up are stored in a read-only memory (ROM) 423. ROM 423 is preferably a non-volatile memory device. A random access memory (RAM) 421 is another memory device and this device contains programs and data that are used by the CPU 403 during routine operation of

client 420. Storage device 425, commonly a magnetic disk drive, contains programs and data used by the client 420 during operation. Such programs include client software which enables the client 420 to communicate with the server 401 over the Internet.

[00213] Commands are sent to the client 420 by an operator (not shown) using an input device 427, which could by way of non-limiting example be a keyboard or a pointing device such as a "mouse" or trackball. Output 429 is provided to display information from the client 420, and can, for example, be a video monitor or a printer. The information displayed may related to the operating status of the client 420 or be controlled by programs running on the client 420.

[00214] A removable storage device 437 can accept, read, and optionally record data on removable media (not shown). By way of non-limiting example, the removable media used by the removable storage device 437 could be a magnetic floppy disk, compact disc (CD) device, a digital video disc (DVD) or a memory card device. Also by way of non-limiting example, the removable storage device 437 can be used to load programs from removable media onto the client 420, or save programs and data from the client 420 onto removable media.

[00215] Client 420 can exchange data with external sources such as server 401 via a data port 431. Where data is to be exchanged over the Internet, data port 431, which by way of non-limiting example could be a cable modem, telephony modem or network connection, is connected to a data line 433, which by way of non-limiting example could be a coaxial cable, a telephone line, or an optical fiber. Data line 433 also could be a wireless connection such as a satellite link.

[00216] Client 420 exchanges data over the Internet through an Internet Service Provider ("ISP") 435. When client 420 receives data from an external data source, client 420 functions as a data recipient. Data passes over data line 433 between the ISP 435 and the data

port 431. The ISP 435 is itself connected to the Internet in a known manner which need not be discussed herein.

[00217] Client 420 could, by way of example only, be a personal computer. Alternatively, the client 420 could be a remote terminal which is connected to a central mainframe computer, a WebTV® unit, a Web-enabled cellular phone, a Web-enabled personal organizer such as a Palm Pilot®, or an Internet appliance, a low-cost device which eliminates certain of a computer's components, such as the hard disk drive.

[00218] As shown in FIG. 10, data can be sent from server 401 through data port 416 to data line 418. The data then passes through the Internet to the ISP 435. ISP 435 sends the data to the client 420 over data line 433 to data port 431.

[00219] Since data transfer takes place over the Internet, data is transmitted between the server 401 and client 420 using Internet transfer protocols such as transfer control protocol and Internet protocol (TCP/IP). Such protocols are themselves known and need not be described in detail herein.

[00220] Although the explanation of this invention describes its use in connection with the Internet, this invention is not intended to be limited thereto. The present invention also could be adapted for use over any other known or future developed networks. By way of non-limiting example, this invention could also be used over an Ethernet local area network.

[00221] Likewise, although the foregoing explanation of the preferred embodiment of this invention discusses the transfer of medical and educational information , this invention is not to be limited thereto. It is envisioned that the concepts taught herein could be applied to the transmission of any type of educational information over a computer network.

[00222] Thus, while there have been shown and described and pointed out novel features of the present invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the

disclosed invention may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

[00223] It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall there between. In particular, this invention should not be construed as being limited to the dimensions, proportions or arrangements disclosed herein.